

WHAT IS CLAIMED IS:

1. A protein sensing molecule that is capable of binding an analyte in a sample, the protein sensing molecule comprising:
 - 5 a first detectable quality that changes in a concentration dependent manner when the protein sensing molecule is bound to the analyte; and
 - a second detectable quality that does not undergo substantial change when the protein sensing molecule is bound to the analyte.
- 10 2. The protein of claim 1, wherein the first detectable quality comprises a label.
3. The protein of claim 1, wherein the second detectable quality comprises a label.
- 15 4. The protein of claim 1, wherein the first detectable quality comprises a label, and wherein the second detectable quality comprises a label that is different from the label of the first detectable quality.
- 20 5. The protein of claim 1, wherein the first detectable quality comprises a polarity-sensitive fluorophore label.
6. The protein of claim 1, wherein the first detectable quality comprises at least one of acrylodan and anilino-naphthalene sulfonate.
- 25 7. The protein of claim 1, wherein the second detectable quality comprises a fluorophore label.
8. The protein of claim 1, wherein the second detectable quality comprises a long-lived metal complex label.
- 30

9. The protein of claim 1, wherein the second detectable quality comprises a ruthenium complex label or osmium complex label.

10. The protein of claim 1, wherein the second detectable quality is attached at the N-terminal of the protein.

11. The protein of claim 1, wherein the second detectable quality is attached at the C-terminal of the protein.

12. The protein of claim 1, wherein the first detectable quality comprises a polarity-sensitive fluorophore label, and wherein the second detectable quality comprises a long-lived metal complex label.

13. The protein of claim 1, wherein the analyte comprises glutamine.

14. The protein of claim 1, wherein the analyte comprises a naturally occurring sugar, sugar derivative, or sugar analog.

15. The protein of claim 1, wherein the analyte comprises at least one of glucose, lactose, galactose, sucrose, and maltose.

16. The protein of claim 1, wherein analyte binding causes the first detectable quality to be shielded.

17. The protein of claim 1, wherein analyte binding causes the first detectable quality to be unshielded.

18. The protein of claim 1, wherein the protein comprises an analyte-binding site.

19. The protein of claim 1, wherein the protein comprises at least one of modified glutamine-binding protein, modified glucose-binding protein, modified hexokinase, and modified glucokinase.

5 20. The protein of claim 19, wherein the protein is modified by substituting at least one cysteine residue therein.

21. The protein of claim 19, wherein the protein is modified by substituting two cysteine residues therein.

10

22. A method for characterizing a sample, comprising:
contacting a protein sensing molecule with the sample, the protein sensing molecule being capable of binding an analyte in the sample, the protein sensing molecule comprising a first detectable quality that changes in a concentration dependent manner when the protein sensing molecule is bound to the analyte, and a second detectable quality that does not undergo substantial change when the protein sensing molecule is bound to the analyte;

15 measuring the detectable qualities of the protein sensing molecule; and
analyzing the detectable qualities to characterize the sample.

20

23. The method of claim 22, wherein the first detectable quality comprises a label.

24. The method of claim 22, wherein the second detectable quality comprises a
25 label.

25. The method of claim 22, wherein the first detectable quality comprises a polarity-sensitive fluorophore label.

30 26. The method of claim 22, wherein the first detectable quality comprises at least one of acrylodan and anilino-naphthalene sulfonate.

27. The method of claim 22, wherein the second detectable quality comprises a fluorophore label.

5 28. The method of claim 22, wherein the second detectable quality comprises a long-lived metal complex label.

29. The method of claim 22, wherein the second detectable quality comprises a ruthenium complex label or osmium complex label.

10

30. The method of claim 22, wherein the second detectable quality is attached at the N-terminal of the protein.

31. The method of claim 22, wherein the first detectable quality comprises a polarity-sensitive fluorophore label, and wherein the second detectable quality comprises a long-lived metal complex label.

15

32. The method of claim 22, wherein the analyte comprises glutamine.

20 33. The method of claim 22, wherein the analyte comprises a naturally occurring sugar, sugar derivative, or sugar analog.

34. The method of claim 22, wherein the analyte comprises at least one of glucose, lactose, galactose, sucrose, and maltose.

25

35. The method of claim 22, wherein the protein comprises an analyte-binding site.

36. The method of claim 22, wherein the protein comprises at least one of modified glutamine-binding protein, modified glucose-binding protein, modified hexokinase, and modified glucokinase.

30

37. The method of claim 22, wherein the measuring and analyzing comprises modulation sensing.

5 38. The method of claim 37, wherein the modulation sensing is conducted with a modulation frequency of about 1 MHz to about 10 MHz.

39. The method of claim 22, wherein the measuring and analyzing comprises determining the concentration of the analyte, and wherein determining the concentration
10 of the analyte comprises ratiometric sensing.

40. The method of claim 39, wherein the ratiometric sensing comprises dual frequency ratiometric sensing.

15 41. The method of claim 22, further comprising diluting the sample prior to contacting the protein sensing molecule with the sample.

42. A sensor, comprising:
a protein sensing molecule that is capable of binding an analyte in a
20 sample, the protein sensing molecule comprising a first detectable quality that changes in a concentration dependent manner when the protein sensing molecule is bound to the analyte, and a second detectable quality that does not undergo substantial change when the protein sensing molecule is bound to the analyte;
a radiation source for irradiating a sample; and
25 a detector that detects changes in the detectable quality of the first detectable quality and the second detectable quality.

43. The sensor of claim 42, wherein the first detectable quality comprises a label, and wherein the second detectable quality comprises a label.

30